

Forecasting the Long Term Impacts of EPA's Green Power Partnership Program

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Abstract

Recognizing that the use of renewable energy can reduce harmful air emissions from the electric power industry but that barriers remain to increased deployment of these clean energy technologies, the EPA, under its newly formed Energy Supply and Industry Branch, plans on developing tools, analysis and programs to support increased renewable energy generation. The EPA will do this through its Green Power Partnership Program. While the full suite of specific strategies to be used by the EPA under this program are not yet fully developed, EPA's proposed activities include two critical elements:

- **Voluntary Green Power Support.** Increase customer demand for green power by overcoming barriers hindering green power markets, including product credibility, cost, and lack of awareness.
- **Renewable Energy Policy and Wind Strategy Support.** Develop policy-related tools and materials to increase the number and strength of state and federal renewable energy policies, and reduce barriers to wind development.

To estimate the potential impacts of EPA's Green Power Partnership Program on renewable energy development and greenhouse gas emissions, Lawrence Berkeley National Laboratory (LBNL) developed and used two analysis tools. First, to gauge the potential impact of EPA's voluntary green power support programs, LBNL modified a green power demand model previously developed by LBNL. Second, LBNL modified the Energy Information Administration's (EIA) Annual Energy Outlook 2001 (AEO 2001) reference case forecast of non-hydro renewable generation to estimate the impact of EPA's policy and strategy support programs. Using these tools, LBNL analyzed two program impact scenarios formulated by the EPA, varying in aggressiveness. This paper presents the methods employed and the results of the analysis.

In summary, based on this analysis and the modeling assumptions provided by EPA, the following table shows the aggregate potential impact of EPA's Green Power Partnership Program on new or incremental renewable energy generation and carbon emissions, relative to a "business as usual" forecast of renewable energy supply and demand absent EPA's programs. Based on historic renewable energy development patterns, at least, this analysis suggests the potential for significant positive impacts from EPA's programs.

	EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020
New Renewable Generation (TWh)	5.7	15.5	36.7	17.0	45.8	74.9
Carbon Avoided (MMTC)	1.6	4.2	9.8	4.6	12.4	20.2

Acknowledgements

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I. Introduction

The introduction of customer choice in electricity markets across the United States is creating new opportunities for customers to directly support renewable energy generation. Within restructured markets, customers are being given the opportunity to purchase “green” power products from competitive electricity suppliers. Meanwhile, within regulated markets, electric utilities are increasingly giving their customers the option of purchasing renewable energy through green pricing programs. At the same time, public policy and market drivers are helping to directly increase the supply of renewable energy. State policy measures such as renewable portfolio standards and system-benefits charges, along with cost reductions in renewable energy projects, are especially notable.

Despite some recent progress in increasing the market opportunities for renewable energy, however, substantial barriers still exist to further deployment. The EPA recognizes the potential that renewable energy holds to reduce harmful air emissions from the electric power industry and the barriers that remain to increased deployment. Accordingly, the EPA, under its newly formed Energy Supply and Industry Branch, plans on developing tools, analysis and programs to support increased renewable generation through its Green Power Partnership Program. While the full suite of specific strategies to be used by the EPA under this program are not yet fully developed, EPA’s proposed activities include two critical elements:¹

- **Voluntary Green Power Support.** Increasing customer demand for green power by overcoming barriers hindering green power markets, including product credibility, cost, and lack of awareness.
- **Renewable Energy Policy and Wind Strategy Support.** Developing policy-related tools and materials, and reducing barriers to wind development, which will increase the number and strength of state and federal renewable energy policies and reduce barriers to further renewable energy development.

The EPA wishes to develop internal performance metrics for their programs, and estimate the potential impacts of those programs on renewable energy development and greenhouse gas (GHG) emissions. Using analysis tools developed by Lawrence Berkeley National Laboratory and inputs provided by the EPA, this paper presents the results of this evaluation. Estimates of the potential impacts of EPA’s Green Power Partnership Program on renewable energy generation and GHG emissions reduction are emphasized.

¹ More information of the specific features of these programs can be obtained from EPA.

II. Methods

A. Overview

EPA's two program areas, (1) voluntary green power support and (2) renewable energy policy and wind strategy support, required separate treatment for modeling purposes.

- **Voluntary Green Power Support.** Estimated impacts of EPA's programs to support the green power market were quantified using Lawrence Berkeley National Laboratory's (LBNL) model of projected growth in green power markets. This model had previously been developed by LBNL² to simulate the growth of the nationwide green power market under differing input assumptions. Green power activity in both competitive markets and regulated markets are included in the model. As such, the model provides a useful tool to estimate the potential impacts of the EPA's Green Power Partnership Program.
- **Policy and Strategy Support.** The potential impacts of EPA's programs on the creation or expansion of renewable energy policies, and the reduction in barriers to renewable energy deployment, are modeled separately and more simply as an increment to EIA's AEO2001 reference forecast for non-hydro renewable energy generation.

In both cases, two separate EPA-specific scenarios, representing two examples of the potential impacts that the EPA's programs could have on the renewable energy market, were developed. Scenario-specific assumptions were created, run through the respective models, and compared against base-case scenarios that are intended to represent "most likely" benchmarks for renewable energy growth in a "business as usual" environment (i.e., absent the EPA's programs). Differences in renewable energy supply and carbon emissions avoidance between the EPA-specific scenarios and the base-case scenarios provide estimates of the potential impacts of the EPA's programs.

The detailed design of EPA's various programs had not been finalized and provided to LBNL prior to the initiation of this project. Accordingly, all input assumptions for the EPA-specific scenarios were formulated and approved by EPA. These scenarios are not intended to directly bound the possible impacts of the EPA's programs, but instead to demonstrate the sensitivity of our results to different assumptions and to provide a range of possible impacts. We note, in particular, that plausible, less aggressive scenarios could easily have been constructed.

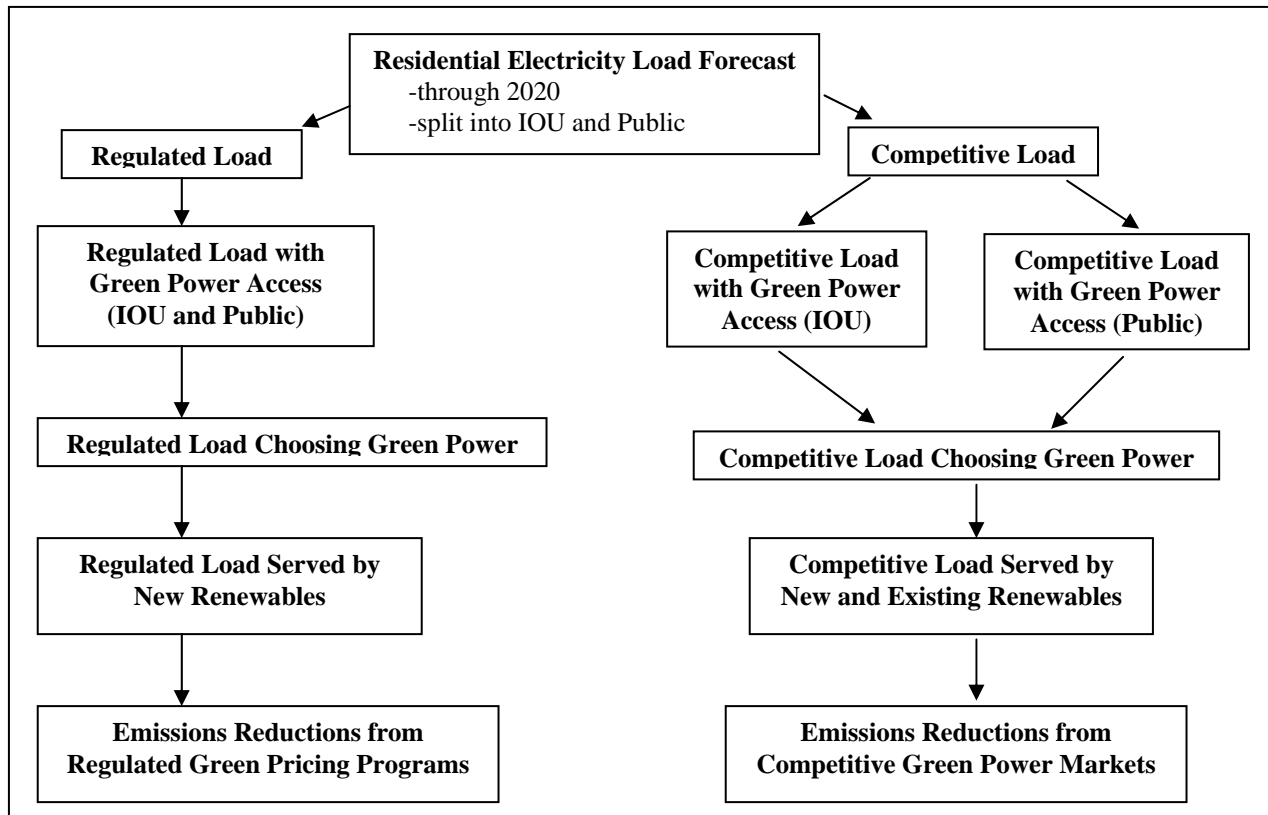
² Assistance in model development was provided by the National Renewable Energy Laboratory and Ed Holt & Associates, with funding from the U.S. Department of Energy.

B. Voluntary Green Power Support

Model Structure

Figure 1 depicts the basic functions of LBNL’s model of green power market growth. At the core of the model is a state-level forecast of residential electricity load through 2020 (based on EIA data), split into investor- and publicly-owned utilities (“IOU” and “Public”). To this load base, the model sequentially applies twenty-year assumptions of green power market access, green power market penetration, and green power product quality variables that differ by regulated and competitive markets, and in some cases also by IOU and public utilities.

FIGURE 1. FLOW CHART OF LBNL GREEN POWER MARKET GROWTH MODEL



In particular, starting at the top of the flow chart, the model divides the residential load data into regulated and competitive markets, based upon specific dates contained in state restructuring legislation (where available) or assumptions about the pace of electricity restructuring in different regions of the country. Next, the model multiplies green power market access assumptions (in percentage form) by the load base to arrive at the amount of electricity load with access to green power in both competitive and regulated markets.³ The model then multiplies green power penetration rate assumptions for both the residential and non-residential sectors by the amount of load with access to green power to determine the amount of load choosing green

³ Note that the market access assumptions differ between IOU and public utility load in competitive markets, reflecting the assumption that public utilities – which are normally exempt from restructuring orders – will be slower to open their markets to competition.

power. Finally, the model multiplies assumptions about the percentage of new and existing renewable energy in the average green power product by the amount of load choosing green power to determine the amount of load being supplied by new and existing renewable energy. Given current average emissions profiles for each state (from the EPA's E-GRID97 database), the model then estimates the reduction in emissions attributable to green power markets assuming that only new renewable generation provides emissions reduction benefits. Other specific features of the model are described in Text Box 1.

Base-Case Model Assumptions

Previous LBNL analysis has resulted in the construction of green power demand scenarios under "high-case" and "low-case" conditions. To evaluate the potential impacts of the EPA's Green Power Partnership Program, construction of a business-as-usual "base-case" scenario was necessary. Our base-case assumptions therefore intend to represent a "middle ground" between the low and high cases that LBNL had constructed previously. The low and high case assumptions and results will be published in a joint LBNL-NREL paper, funded by the U.S. DOE, later this year. Readers are referred to that document for more information of the nature of the model and its assumptions. Table 1 identifies a number of the key base-case assumptions.

Assumptions Specific to the EPA Green Power Partnership Program

EPA plans on implementing the Green Power Partnership Program in several stages. Starting in 2001, EPA expects to target regulated utility green pricing programs nationwide, as well as the non-residential end-use sector in the competitive markets of Pennsylvania and Texas. Over time, EPA plans on expanding the reach of their programs. For modeling purposes, in 2002 we simulate an expansion of EPA's non-residential focus to the competitive markets in Connecticut, Massachusetts, New York, and New Jersey, followed by Maine, Rhode Island, and California in 2003, and Illinois, Michigan, and Ohio in 2004. In 2005, EPA expects to expand its non-residential focus to all competitive markets, and EPA also plans to begin targeting the residential end-use sector in competitive markets nationwide. This timeline holds for both of the two scenarios modeled here. Only estimates of the effectiveness of the EPA's Green Power Partnership Program differ between scenarios.

In constructing the two EPA-specific scenarios, we decided that it is unlikely that the Partnership Program would directly influence the pace of electricity restructuring. It is possible, however, that the Program could influence access to green power, residential and non-residential penetration rates, and green power product quality. These are the variables we altered from the base case to construct two EPA-specific scenarios that are intended to reflect the potential effects of the Partnership Program.

These two EPA-specific scenarios differ in two key respects. First, while both achieve the same levels of residential and non-residential penetration over time, Scenario 2 ramps up more aggressively in the early years, achieving those levels sooner. Second, Scenario 2 assumes that the Partnership Program will positively influence the quality of green power products offered, whereas Scenario 1 assumes no change in the base-case product quality assumptions. Specific EPA-scenario assumptions are listed in Table 2, all of which were formulated and approved by EPA, with assistance from LBNL.

TEXT BOX 1: MODEL SPECIFICS

Load Base Forecast

The Energy Information Administration (EIA) does not forecast residential electricity loads by state, so we constructed our own state-level forecast through 2020, using other EIA data. Our forecast begins with actual 1998 residential electricity sales by state, split into investor- and publicly-owned utilities (“IOU” and “public utility”). To this state-level base we apply regional growth rates from the EIA’s Annual Energy Outlook 2000 forecast of residential electricity consumption by census region. Thus, the load of each state (and IOU and public utility) within a region grows at the regional growth rate.

Twenty Year Assumptions

We constructed our assumptions generically. These *national* assumptions are then applied to each state, either “as is” in states with no current green power markets, or on an incremental basis in states that already have a green power track record. In other words, in those states where green power has made inroads and data on access to green power, market penetration, and product quality are available (or can be accurately estimated), we use such data as the starting point for our forecasts, and apply our assumptions by adding the *change* in assumptions from one year to the next to the starting value.

Transitioning from Regulated to Competitive Markets

States that have set a “firm” restructuring date either legislatively or by other means are assumed to open their markets to competition one year after that date in the base-case. States that have not yet set a date to open their markets are subjectively assigned either “fast track” or “slow track” status, which governs how soon after January 1, 2004 they open to competition. Indiana, Vermont, and Wisconsin are the only “fast track” states; all others that have not made firm plans to restructure are considered to be on a “slow track”.

As a state opens its market to competition, competitive assumptions take over from regulated assumptions. Gains made in regulated markets, however, are not discarded. We assume that those who had participated in regulated utility green pricing programs will, within a reasonably short period, choose a competitive green power provider, and that any renewable generation built to serve a regulated green pricing program will also serve green power products in a competitive market. Thus, the model preserves all gains made in regulated markets, essentially “freezing” them at the time of restructuring.

Finally, our twenty-year assumptions for competitive markets are referenced to the inception date of open markets (e.g., “by the second year of open markets, we expect green power market penetration to reach x%”) instead of the year 2000, and therefore our assumptions apply to different calendar years for different states, depending on when each state restructures its electricity markets. Regulated markets do not share this peculiarity, and so our assumptions for regulated markets do follow the calendar (e.g., “year 1” is 2001).

Other Specifics

Various caps are employed throughout the model. One cap ensures that our assumptions do not increase beyond 100%. Another ensures that our forecast of access to green power in regulated markets never falls below a state’s year 2000 starting point (unless our assumptions decrease), and never grows above the national maximum forecast for regulated green pricing access over the entire forecast period.

The model is conservative in its treatment of access to green power in both competitive and regulated markets. Specifically, each year’s new incremental load with access to green power reverts to “year 1” assumptions about green power market penetration. For example, even if a competitive market has been open for 5 years, any new load gaining access to green power in year 5 will only achieve the green power market penetration rate assumption from year 1. This mechanism essentially treats all incremental access to green power as if it were a new market starting from scratch. While such conservatism may be justified with respect to assumptions about green power market penetration, it is arguably less so with respect to product quality assumptions. Thus, this mechanism was *not* employed for product quality; any incremental load choosing green power in year five will receive year-5 product quality.

TABLE 1. BASE-CASE MODEL ASSUMPTIONS

Pace of Restructuring	States that have already set a date to open their markets to retail competition are assumed to delay direct access by one year, due to the fear engendered by the current turmoil in California (with the exception of Texas, which is expected to begin retail competition in 2002 as planned). States that have not explicitly set a date for restructuring are assumed to begin to open their markets at the earliest in 2004, with the specific pace of restructuring after that date varying by region (e.g., because most other northeastern states have already restructured, Vermont is assumed to open its markets more quickly than, for example, Alabama). Specifically, one-third of “fast track” states are expected to open their markets in 2004, followed by another third in 2005 and the rest in 2006. “Slow-track” states proceed more cautiously: 5% open their markets in 2004, rising in 5% increments each year until reaching 60% in 2015 (thus, some slow-track states never restructure). IOUs are assumed to be impacted directly by state-level electricity restructuring decisions. Publicly-owned utilities, on the other hand, are assumed to be much slower in opening their markets to competition (starting at just 2.5% of load in the third year of retail competition, and growing to only 30% over 11 years).
Access to Green Power	5% of all regulated load that does not already have access to a green power product is assumed to gain access to a green pricing program in 2001, growing to 50% in 2010. This growth path is in addition to the roughly 15% of customers that currently have access to a green pricing program. We further assume that all markets that are fully open to retail competition will contain at least one green power option.
Green Power Market Penetration	For both regulated and competitive markets, we assume that residential green power market penetration starts at 0.5% in the first year of green power choice, and grows to 6% over 11 years. This growth path seems feasible given current average residential market penetration rates of 1%-2% after just a few years of experience, and penetration rates of up to 7% for a few programs. Non-residential green power demand is assumed to be a percentage adder to residential demand. The base case assumes that non-residential demand remains constant at 20% of residential demand; this assumption is also in line with current market experience.
Green Power Product Quality	Regulated green pricing programs are assumed to supply only new renewables, in an amount equal to 30% of a typical residential customer’s load. Competitive green power products are assumed to contain a blend of new and existing renewables, with generation from existing renewable energy plants supplying a constant 25% of the product over time, and new renewables growing from 2% to 20% over 9 years.

TABLE 2: EPA-SPECIFIC MODEL ASSUMPTIONS

Regulated Green Pricing Programs	We assume that the EPA's efforts double the base-case impact of regulated green pricing programs (in terms of green kWh) in all states by 2020 in Scenario 1 (in 5%/year increments starting in 2001) and by 2010 in Scenario 2 (in 10%/year increments starting in 2001). This doubling could reflect either an increase in the number of customers subscribing to existing green pricing programs or an increase in the number of green pricing programs offered (or some combination thereof).
Competitive Residential Penetration	Assuming that the EPA's programs begin to focus on the residential market in 2005 and that all restructured states are covered by the programs, in Scenario 1 we increased the base-case green kWh associated with residential demand by 5% in 2005, growing in 5% increments until hitting 50% in 2016 and then 66.6% in 2017 (through 2020). The 66.6% increase takes residential penetration from the high of 6% in the base case to a high of 10% under Scenario 1. In Scenario 2 residential demand is expected to increase more rapidly. In particular, we increased the base-case green kWh associated with residential demand by 33.3% in 2005, growing in 3.3% annual increments until again reaching 66.6% in 2015 (through 2020). The 66.6% increase also takes residential penetration from the high of 6% in the base case to a high of 10% under Scenario 2, though this high is reached more quickly than under Scenario 1.
Competitive Non-Residential Penetration (as a Percent of Residential)	We assume that the EPA's programs and their focus on increasing non-residential demand for green power will triple the base-case impact in 20 years under Scenario 1 (from a 20% adder to residential demand to a 60% adder in 20 years in 2% increments per year), and 11 years under Scenario 2 (incrementing to 30% immediately and increasing in 3% increments to 60% in year 11). Both scenarios target Pennsylvania and Texas starting in 2001; Connecticut, Massachusetts, New Jersey, and New York starting in 2002; Maine, Rhode Island, and California starting in 2003; Illinois, Michigan, and Ohio starting in 2004; and all other restructured states starting in 2005.
Regulated Product Quality	Under Scenario 2 only, we assume that the Partnership Program will boost the percentage of new renewables by ten percentage points by 2005 (increasing in 2% annual increments beginning in 2001).
Competitive Product Quality	Under Scenario 2 only, new renewables product content increases from 4% to 32% in 4% increments over 8 years, compared to the base-case assumption of 2% to 20% in 2% increments over 9 years.

C. Policy and Strategy Support

Model Structure

Neither of the above scenarios accounts for any of the Program's planned activities to work with state governments on renewable energy policies and to reduce barriers to renewable energy development through regulatory assistance. These activities would be expected to further increase the impacts of the Partnership Program, and a methodology was needed to evaluate these possible impacts.

Our approach in this case was to use an industry standard forecast of renewable energy generation developed by the Energy Information Administration (EIA), and to assume that EPA's programs would have the effect of increasing this base-case projection by a fixed percentage amount. Absent further information on the nature and focus of EPA's programs in policy and strategy support, this approach appeared to offer the simplest method without sacrificing a great deal of useful model detail.

Model Assumptions

For the base-case, we use EIA's Annual Energy Outlook 2001 (AEO2001), which presents forecasts of energy supply, demand and prices through 2020 based on results from the National Energy Modeling System (NEMS). AEO2001 includes projections of the quantity of non-hydro renewable generation in the United States through 2020. EIA assumptions for renewable energy costs, resources, operational characteristics, and traditional generation sources are used to develop these projections. EIA's AEO reference, or base-case assumptions also attempt to take into account policies that are currently in existence to help support renewable energy. While there has been considerable debate on the appropriateness of AEO's treatment of renewable energy sources through the use of NEMS, the model and its results remain the standard government forecast and AEO2001 is therefore appropriate for our purposes.

To develop projections of the potential impacts of EPA's programs, AEO2001's forecasts for non-hydro renewable generation through 2020 are first compared to the current amount of non-hydro renewable generation (in 2000, as reported in AEO2001). The difference represents AEO2001's projected growth in renewable generation over time.

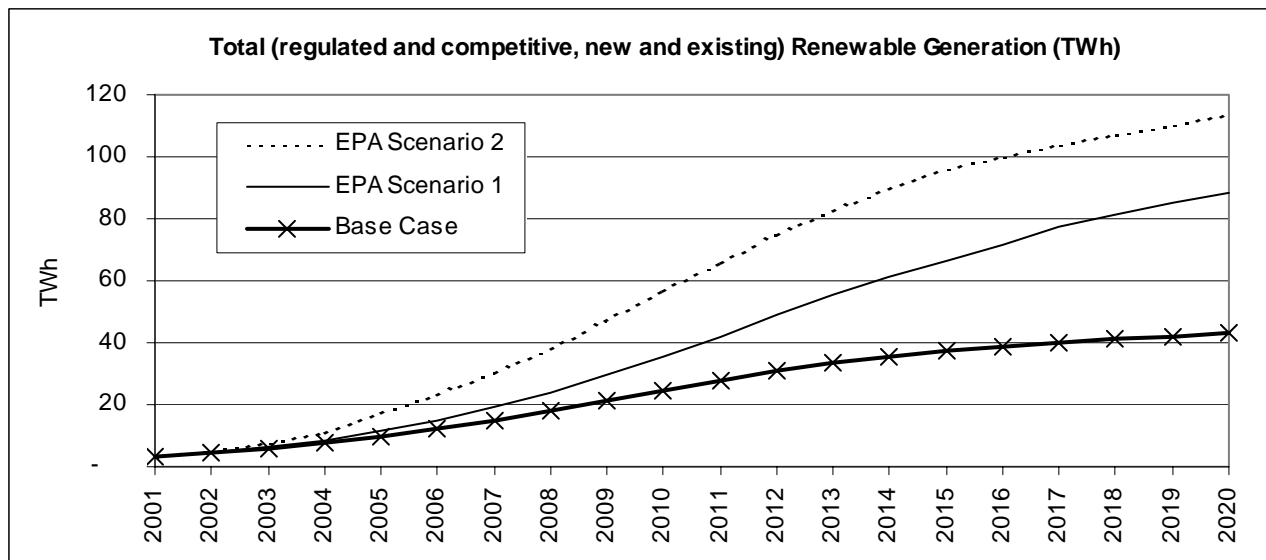
Under our "high-case" assumptions for the impact of EPA's policy and strategy programs, we simply assume that EPA's programs could increase the projected growth in renewable generation over time by 50%, relative to the AEO2001 projection (Scenario 2). Under our "low-case" assumptions, on the other hand, we assume that the relative increase is 20% of the AEO-forecasted growth (Scenario 1). Nationwide average emissions factors from E-GRID97 are then used to estimate the potential emissions reduction from this increased growth.

III. Results

A. Voluntary Green Power Support

Recognizing that any market forecast beyond even a few years is subject to considerable uncertainty, Figure 1 begins to present the results of the modeling analysis for the voluntary green power support programs planned by EPA. In particular, Figure 1 shows the total amount of renewable generation serving the green power market in both the base-case analysis and in the two EPA-specific scenarios over our 20-year forecast period. Under this analysis, EPA's programs are projected to double (Scenario 1) and nearly triple (Scenario 2) total renewable generation serving the green power market compared to the base-case results, indicating a significant affect from EPA's proposed programs.

FIGURE 1. TOTAL RENEWABLE GENERATION SERVING THE GREEN POWER MARKET



Of course, not all of this renewable generation will come from new resources. Accordingly, Table 3 subdivides the total amount of renewable generation depicted in Figure 1 into new and existing generation, and adds the resulting amount of annual carbon emissions avoided. Note that we assume that all renewable generation is zero-emission,⁴ and that only new renewable generation provides credible emissions reductions.⁵ LBNL's model forecasts these outputs annually to 2020; Table 3 presents results for 2005, 2010, and 2020.

⁴ The assumption that renewable generation is zero-emission is contestable. Landfill gas may in fact have a *negative* emissions profile as it not only offsets emissions from fossil-fuel generation, but may also reduce damaging methane emissions. The combustion of biomass, on the other hand, may result in considerable carbon emissions if the feedstock is not obtained in a sustainable manner.

⁵ It is commonly assumed that pre-existing renewable generation facilities would continue to operate in the absence of green power markets, and so it is only the new or incremental generation that comes on line as a result of green power market demand that provides credible emissions reduction benefits.

TABLE 3. LBNL MODEL FORECASTS OF BASE-CASE AND EPA VOLUNTARY GREEN POWER SUPPORT PROGRAM SCENARIOS

	Base Case			EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020	2005	2010	2020
Existing Renewable Generation (TWh)	4.1	9.3	17.2	4.4	13.3	34.4	5.8	16.8	35.4
New Renewable Generation (TWh)	5.9	15.1	26.0	7.2	22.2	52.8	11.7	39.9	76.3
Carbon Avoided (MMTC/year)	1.6	4.1	6.9	2.0	6.0	14.1	3.2	10.7	20.5

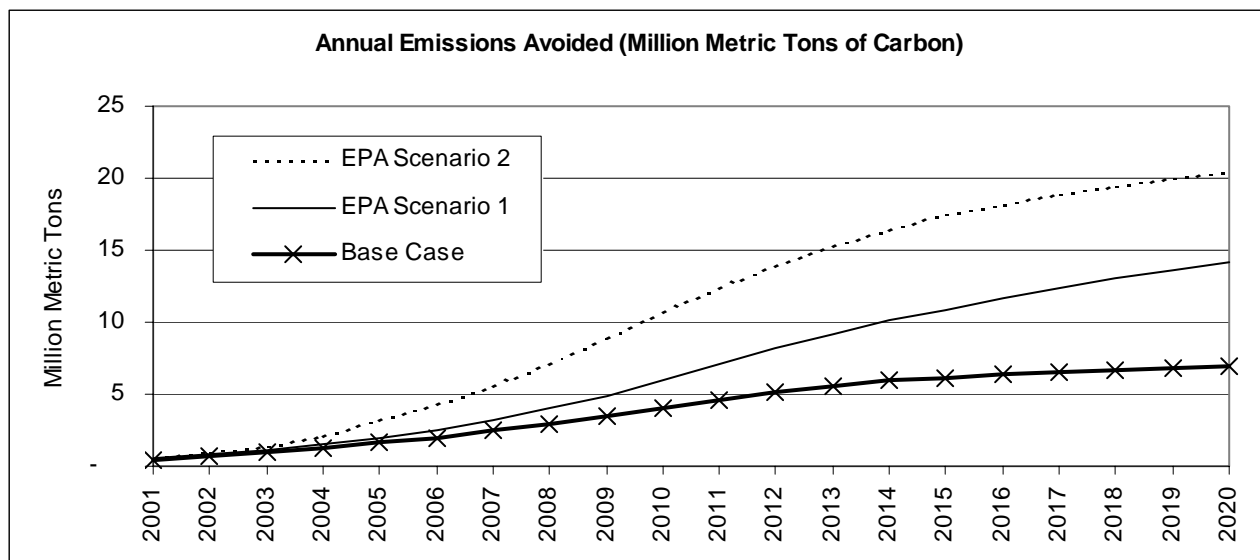
Compared to the base-case scenario, by 2020 Scenario 1 represents a doubling in new renewable generation and carbon avoided from green power demand. Meanwhile, Scenario 2, intended to reflect a more aggressive case, represents a tripling of new renewable generation and carbon avoided relative to the base-case forecast in 2020. Table 4 shows the estimated impact of the EPA's voluntary green power support programs relative to the base case, by subtracting the base case forecasts in Table 3 from the EPA Scenario 1 and 2 forecasts.

TABLE 4. PROJECTED IMPACTS OF EPA'S VOLUNTARY GREEN POWER SUPPORT PROGRAMS RELATIVE TO THE BASE CASE

	EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020
Existing Renewable Generation (TWh)	0.4	4.0	17.2	1.8	7.5	18.2
New Renewable Generation (TWh)	1.2	7.1	26.9	5.8	24.8	50.4
Carbon Avoided (MMTC/year)	0.3	1.9	7.2	1.6	6.7	13.5

Based on this analysis, program impacts in terms of increased new renewable generation range from 26.9 TWh/year under Scenario 1 to 50.4 TWh/year under Scenario 2 by 2020. Assuming a 50% average capacity factor, this represents 6,100 MW of new renewable generation in Scenario 1 and 11,500 MW in Scenario 2 by 2020. Program impacts by 2005 and 2010 are more modest, with 280 MW and 1,310 MW by 2005 in Scenario 1 and Scenario 2 respectively, and 1,620 MW and 5,650 MW by 2010.

As also shown, program impacts in terms of annual carbon avoidance range from 7.2 MMTCE under Scenario 1 to 13.5 MMTCE under Scenario 2 by 2020. Again, impacts in earlier years are more modest. Figure 2 illustrates the amount of annual carbon emissions avoided under the base case scenario and EPA Scenarios 1 and 2.

FIGURE 2. CARBON EMISSIONS AVOIDED

B. Policy and Strategy Support

As explained in Section II.C., to measure the impact of EPA’s policy and strategy support programs, we used the AEO 2001 reference case as our base-case forecast of renewable energy development over the period 2000-2020 absent EPA’s programs. If anything, we expect that this represents a conservative view of renewable energy supply growth over the time period. Under Scenario 1, we assume that EPA policy and strategy support programs will increase the amount of new or incremental capacity and generation added in the base case by 20%; under Scenario 2, we assume a 50% increase. Table 5 shows the amount of new or incremental (relative to year 2000 levels) capacity, generation, and carbon emissions avoided under the base case and both EPA scenarios. EPA Scenario 1 is merely 120% of the base case, while EPA Scenario 2 is 150% of the base case. We note that these numbers are in addition to year 2000 non-hydro renewable generation of 48.6 TWh, as reported in AEO2001.

TABLE 5. FORECASTS OF AEO 2001 BASE-CASE AND EPA POLICY AND STRATEGY SUPPORT SCENARIOS

	Base Case			EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020	2005	2010	2020
New Renewable Capacity (GW)	3.3	6.5	8.1	3.9	7.8	9.7	4.9	9.7	12.2
New Renewable Generation (TWh)	22.4	42.2	49.1	26.9	50.6	59.0	33.6	63.3	73.7
Carbon Avoided (MMTC/year)	6.1	11.4	13.3	7.3	13.7	15.9	9.1	17.1	19.9

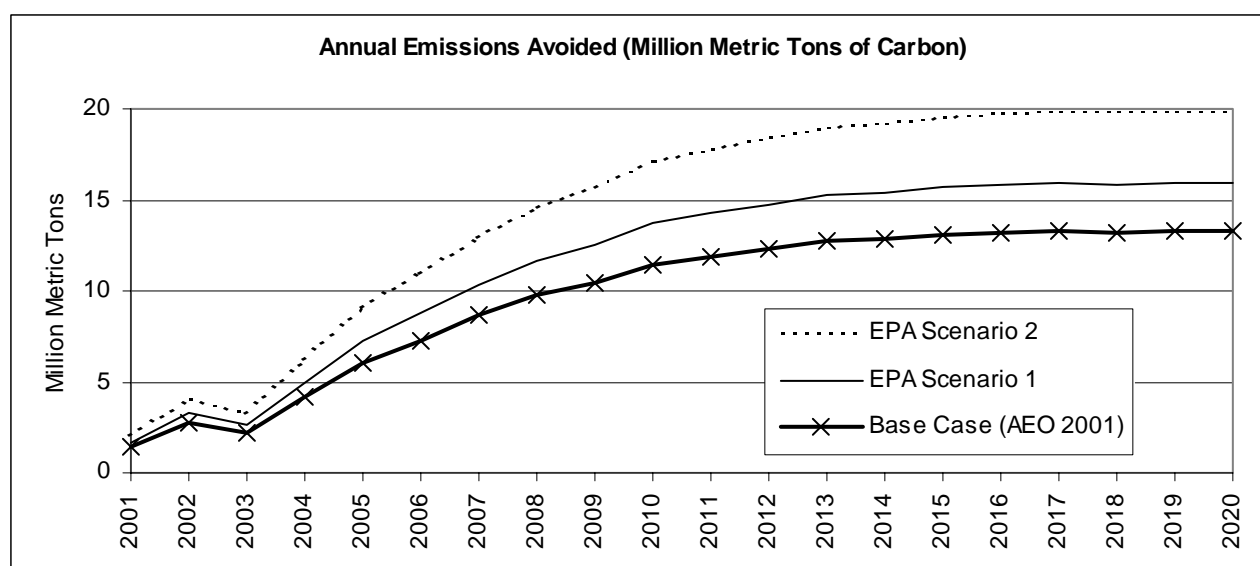
Table 6 shows the impact of EPA’s policy and strategy support programs relative to the base case, by subtracting the base case forecasts in Table 5 from the EPA Scenario 1 and 2 forecasts.

TABLE 6. PROJECTED IMPACTS OF EPA’S POLICY AND STRATEGY SUPPORT PROGRAMS RELATIVE TO THE BASE CASE

	EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020
New Renewable Capacity (GW)	0.7	1.3	1.6	1.6	3.2	4.1
New Renewable Generation (TWh)	4.5	8.4	9.8	11.2	21.1	24.6
Carbon Avoided (MMTC/year)	1.2	2.3	2.7	3.0	5.7	6.6

Table 6 implies, and Figure 3 confirms, that due to the nature of the AEO2001 base case forecast and our assumptions for the impact of EPA’s programs on the EIA forecast, the incremental impact of the EIA programs is projected to stabilize soon after 2010, with most of the growth concentrated between 2003 and 2013.

FIGURE 3. CARBON EMISSIONS AVOIDED, AEO 2001 BASE CASE AND EPA POLICY AND STRATEGY SUPPORT PROGRAMS



IV. Conclusion

Based on LBNL analysis tools and EPA-approved input assumptions, this analysis provides a forecast of the possible impacts of EPA's Green Power Partnership Program. Table 7 aggregates the impact of EPA's voluntary green power and policy and strategy support programs relative to their respective base cases by simply adding the values reported in Table 4 and Table 6. As shown, Scenario 2 is twice as aggressive as Scenario 1 in 2020, and roughly three times as aggressive in 2005 and 2010, representing Scenario 2's more rapid acceleration in earlier years.

TABLE 7. COMBINED IMPACT OF EPA'S VOLUNTARY GREEN POWER AND POLICY AND STRATEGY SUPPORT PROGRAMS RELATIVE TO THE BASE CASE

	EPA Scenario 1			EPA Scenario 2		
	2005	2010	2020	2005	2010	2020
New Renewable Generation (TWh)	5.7	15.5	36.7	17.0	45.8	74.9
Carbon Avoided (MMTC)	1.6	4.2	9.8	4.6	12.4	20.2

As with any forecasts extending more than a few years, these projections are subject to considerable uncertainty. They rely on many assumptions about the scope and growth of green power markets and renewable energy policies, both in the base case scenarios and EPA scenarios. One such assumption is that the EPA programs will be implemented aggressively: it is the opinion of the authors that achieving even the more modest Scenario 1 results will require aggressive implementation by the EPA.

Should EPA's programs succeed in attaining only their Scenario 1 goals, however, the impact will still be quite large by the historic standards of renewable energy deployment in the United States:⁶ nearly 37 TWh of new renewable generation is possible by 2020 as a result of EPA's programs, avoiding nearly 10 million metric tons of carbon emissions that year and thereafter. Moreover, such a large increase in new renewable generation has the potential to create spillover effects in the form of technology cost reductions, which could lead to even further renewables deployment and carbon emissions reductions. Modeling these spillover effects, however, was beyond the scope of this project.

⁶ As of 2000, 48.6 TWh of non-hydro renewable energy existed in the U.S.